Gopher Thermodynamics written test portion answer key
Total points possible: 33
Total questions: 21

Multiple Choice:

1. B
2. B
3. C
4. A
5. D
6. D
7. A
8. C
9. A
10. C
11. a) D
11. b) B
12. D
13. D
14. A
15. B
16. C
17. D

Calculation Questions: **Subtract 0.5 for every boxed final answer that has the wrong number of significant figures. Each question is worth 4 points. Subtract 2 points if not enough work was shown.**

1. Given a Carnot engine that absorbs 750 J of energy from a tank of hot water with a final temperature of 300.0 K, what is the initial temperature if 600.0 J of work was done by the system?

$$\varepsilon=[T_H-T_L]/T_H = w/q$$

Set the two equivalent expressions equal to one another:

$$[T_H-300]/T_H = 600/750$$

Using basic algebra solve for the initial temperature.

$$T_H = 1500 \text{ K (only 2 significant figures)}$$

2. How much energy is transferred if a block of copper with a mass of 50.0 g is heated from 20.0°C to 100.0 °C? The specific heat of copper, Cu, is c = 0.386 J/g°C.

$\Delta T = 100\ °C - 20\ °C = 80\ °C$. The mass, $m = 50$ g.

Use $Q = mc\Delta T$:

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Q = (50 g)(0.386 J/g°C)(80 J/g°C)

Q = 1544 Joules

~ 1540 Joules (3 significant figures)

3. Given 50.0 L of water at 20.0°C, what will be the water's temperature, in **Fahrenheit**, after adding 1829 BTUs of heat? (Assume the density of water is 1g/mL, 1 BTU= 1055.06 J, and the specific heat capacity of water is 4.184 J/g/°C)

Find mass of water: 50 L x 1 g/mL x 1000mL/L= 5000 g
1829 BTU x 1055.06 J/1 BTU = 1929704.74 J
Use Q = mcΔT: 1929704.74J=5000*4.184*ΔT
ΔT=1929704.74/5000/4.184=92.24210038
20+92.24210038=112.2421004
Convert °C to °F: 112.2421004 * 9/5 +32=234.0357807… °F
~234 °F (3 significant figures)

4. What is the average kinetic energy of a gas molecule, in Joules, at 30.0°C? k=1.38 x 10^-23

Convert to Kelvin: T=(30+273.15)=303.15 K
Plug into kinetic energy equation:
KE= 3/2 kT
=3/2*1.38*10^{-23}*303.15
= **6.28 * 10^-21 Joules (3 significant figures)**